Production of ^{260}Lr and ^{253}Fm via the 3n-Exit Channel

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^{260}Lr (3.0 min, 8.030 MeV-α) was produced by the ^{248}Cm(^{15}N,3n) reaction and ^{253}Fm (3.0 day, 6.943 MeV-α) was produced by the ^{238}U(^{18}O,3n) reaction in an attempt to examine the 3n-exit channel as a possible method for the production of neutron-rich isotopes near the stable deformed shell at N=162, Z=108.

K. Eskola et.al.[1] previously reported the production cross section for the ^{248}Cm(^{15}N,3n) reaction at 78 MeV to be 2 nanobarns (nb). In our experiment, 76.5 and 79.2 MeV ^{15}N projectiles were used to produce ^{260}Lr, which was then detected by α and SF activity in our rotating wheel system. From the measured 8.030 MeV α-activity and assuming a 100% α-branch with a 3-minute half-life, we determined the production cross section of ^{260}Lr to be 1.8 ± .8 nb in the 76.5 MeV reaction and 2.6 ± 1.1 nb in the 79.2 MeV reaction. Figure 1 shows our cross section results plotted together with the literature value[1] and theoretical predictions. Our results are consistent with the previously reported literature value.

In the second reaction, ^{18}O was run at several energies to measure the excitation function for the 3n-exit channel. A gold catcher foil was placed directly behind the ^{238}U target to collect all of the recoiling products. According to previous calculations[2], the collection efficiency of the catcher foil should be nearly 100%. After irradiating the target for eight hours, the irradiated gold catcher foil was removed and dissolved in aqua regia. The resulting solution passed through an AG1-X8 anion exchange resin (200-400 mesh) column. The trivalent actinides passed through, while the gold, higher valent actinides and reaction products sorbed on the column. The trivalent fermium fraction was collected and dried on a Pt disk and counted with a silicon solid-state alpha-spectrometer system. In one circumstance, the trivalent actinide fraction was sorbed on a Dowex 50-X4 cation exchange resin (200-400 mesh) column and eluted with 0.5 M α-hydroxyisobutyrate at a pH of 3.38 to successfully separate the desired fermium fraction from the rest of the trivalent actinides. The resulting fermium fraction was collected and dried on a Pt disk and counted with our silicon solid-state alpha-spectrometer system.

Analysis of the α-data from these samples showed no detectable ^{253}Fm but, ^{252}Fm (1.058 day, 7.039 MeV-α) was detected. However, the ^{252}Fm cross section at 95 MeV was nearly a factor of 3 smaller then the previously reported value of 520 nb at 94 MeV[3]. This may indicate that the effective thickness of the ^{238}U target was less than determined initially.

New experiments on the ^{248}Cm(^{15}N,3n)^{260}Lr and ^{238}U(^{18}O,3n)^{253}Fm reactions as well as new reactions ^{238}U(^{22}Ne,3n)^{257}No and ^{249}Bk(^{18}O,α2n)^{261}Lr are planned for the future.

Footnotes and References

1. Eskola, K., Eskola, P., Nurmia, M., Ghiorso, A., Phys. Rev. C **4**, 632 (1971).
2. Leyba, J.D., LBL Report LBL-29540 (1990).
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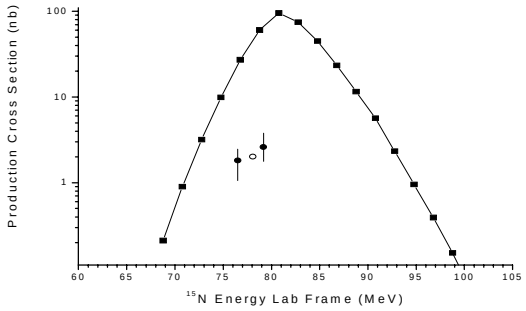

Fig. 1. Theoretical excitation function for the ^{248}Cm(^{15}N,3n)^{260}Lr reaction. Closed circles with error bars are values from this experiment. Open circle is a reported literature value.